NEW PREY RECORDS FOR SPIDER HUNTING WASPS (HYMENOPTERA: POMPILIDAE) FROM THE NETHERLANDS

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In the southern Netherlands, 56 spider prey were collected, and identified, together with their pompilid predators. Those data are compared with data from the literature for northwestern Europe. *Anoplius* spp. seem to prey mainly upon ground dwelling spiders. A strong preference for the wolf spider *Trochosa terricola* was found for *Anoplius viaticus*, in agreement with data from Bristowe (1948). *Episyron rufipes* and *Caliadurgus fasciatellus* attack only orbweb building spiders. Data for *Auplopus carbonarius* and *Dipogon subintermedius* suggest that these species prefer to hunt on vertical planes like tree-trunks. *Arachnospila rufa*, *Pompilus cinereus*, and *Priocnemis* spp. appear to be non-selective.

Dans le sud des Pays-Bas, 56 araignées, proies de Pompilides, on été récoltées avec leurs prédateurs et identifiées. Les données acquises ont été comparées avec les celles de la littérature concernant les observations réalisées aux Pays-Bas et dans les pays voisins. *Anoplius* spp. montre une nette prédilection pour les araignées tericoles. Conformément aux données de Bristowe (1948), *Anoplius viaticus* préfère de loin *Trochosa terricola*. *Episyron rufipes* et *Caliadurgus fasciatellus* s'attaquent seulement aux araignées qui construisent des toiles orbiculaires. Les observations sur *Auplopus carbonarius* et *Dipogon subintermedius* suggèrent que ces espèces chassent de préférence sur des plans verticaux comme des vieux murs ou des troncs d'arbres. *Arachnospila rufa*, *Pompilus cinereus* et les *Priocnemis* spp. semblent être des espèces non sélectives. □*Araneae, predation, Pompilidae, selectivity, The Netherlands.*

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Female Pompilidae attack and paralyse spiders with their sting. Each captured spider is the food of a larva that hatches from an egg laid on the spider. Before oviposition, most European pompilids transport their prey to burrows excavated in the soil, or to pre-existing cavities, e.g., behind bark or between stones (Gauld & Bolton, 1988). Knowledge of pompilid prey is limited for obvious reasons: most hymenopterists are interested only in pompilids and not so much in their prey. Arachnologists tend to accept prey of Pompilidae gratefully, but without identifying their predators. As a consequence, data on prey hardly exist, are out of date and/or are unreliable because of changed taxonomic views, or do not go beyond generic level (e.g., Day, 1988; Oehlke and Wolf, 1987). However, collectively, all published data suggest some prey specialization, but it is not clear if this is due simply to opportunistic behaviour of pompilids, catching only (or mainly) the most abundant prey. A way to gather more knowledge concerning possible preferences of pompilids, is to catch pompilid predators *with* their prey, and to accurately identify them both. Autecological information on the spiders may give a clue as to whether pompilid species only catch what they can, or prefer, for some reason, some species of prey over others. This paper reports on the first results of such a study which began in 1987.

METHODS AND MATERIALS

Pompilids were studied at several locations, mainly in the southern Netherlands, near of Tilburg. Unless stated otherwise, the second author located pompilids by eye and intercepted prey-transporting females using glass tubes and an insect-net. Prey were collected and preserved in alcohol. Predators were collected only if identification in the field was not possible. Wasps were identified with the aid of Wolf (1972), Day (1988) and Oehlke and Wolf (1987). Identification of spiders was based mainly on Roberts (1985ab, 1987). Not all spiders could be identified to species level, because some were juvenile, thus lacking the genital organs necessary for a proper identification. Autecological data on spiders are derived from Jones (1983) and Maurer and Hänggi (1990). All spiders and wasps collected will be lodged in the National Museum of Natural History, Leiden, The Netherlands.

RESULTS

In total, 56 pompilid prey were collected. Data are summarized below. For each specimen the specific date and collecting site are given because both may have influenced hunting behaviour of the wasps. When more than one prey record is available for a single pompilid species, common characteristics of the prey are given that may point to a preference of the actual wasp.

POMPILINAE:

Anoplius concinnus (Dahlbom): *Pardosa* sp. (1 juv., Thorn, 13.x.1990); *Trochosa ruricola* (Degeer) (1♂, Thorn, 13.x.1990). Both are wolf spiders, Lycosidae. They were excavated from a, supposedly, single burrow between pebbles in a gravelpit, after a female *A. concinnus* had been observed showing nest building activity.

Anoplius infuscatus (Vander Linden): Lycosidae (1 juv., Moergestel, 30.iv.1988); *Alopecosa accentuata* (Latreille) (1 juv. Nieuw-Bergen, 6.ix.1991). Both are wolf spiders.

Anoplius viaticus (Linnaeus): *Agroeca brunnea* (Blackwall) (1♀, Beegden, 12.v.1991); *Trochosa terricola* Thorell (1♀ excavated, Alphen en Riel, 5.v.1989; 1♀+1♂, do., 3.v.1988; 1♀, 15.iv.1989, Apeldoorn; 7♀, Beegden, 12.v.1991; 1♀, Hilvarenbeek, 1.v.1988; 3♀+1♂, Berkel-Enschot, 5.v.1989; 1♀, Drunen, 9.v.1989; 1♀, Loon op Zand, 12.iv.1991; 1♀ excavated, Moergestel, 24.iv.1989; 2♀, do., 27.iv.1989; 2♀, do., Moergestel; 2♀, do., 5.v.1989; 1♀, do., 29.v.1989; 1♀, do., 23.vi.1989; 10♀+1♂, do., 29.iii.1990); *Pardosa monticola* (Clerck) (1♀, Beegden, 18.v.1989). All three species are ground dwelling spiders.

Arachnospila rufa (Haupt): *Alopecosa fabrilis* (Clerck) (1♂, Nieuw-Bergen, 1.ix.1991).

Auplopus carbonarius (Scopoli): *Haplodrassus* sp. (1 juv. found in a beehive in one of a group of barrel-shaped cells typical of *A. carbonarius* (Grandi, 1961: 75; Wahis, 1949: 99), Baarle-Nassau, 1991); *Clubiona brevipes* Blackwall (1♀, Udenhout, 11.viii.1990). Both are nocturnal hunters often hiding in silk retreats during the day.

Episyron rufipes (Linnaeus): *Larinioides cornutus* (Clerck) (1♀, Helvoirt, 16.viii.1991); *Nuctenea umbratica* (Clerck) (1 juv., Moergestel, 26.vi.1990). Both are orbweb building spiders.

Pompilus cinereus (Fabricius): Lycosidae (1 juv., Moergestel, 4.viii.1987).

PEPSINAE:

Caliadurgus fasciatellus (Spinola): *Agelenatea redii* (Scopoli) (1 juv., Moergestel, 4.x.1989).

Dipogon subintermedius (Magretti): *Segestria senoculata* (Linnaeus) (1♀ found in a cavity in an old pollard-willow (*Salix alba*), Tilburg, 23.vii.1991).

Priocnemis fennica Haupt: *Clubiona terrestris* Westring (1♀, Hilvarenbeek, 29.ix.1990).

Priocnemis minuta (Vander Linden): Gnaphosidae (1 juv., Moergestel, 17.viii.1988).

Priocnemis susterai Haupt: *Drassodes cupreus* (Blackwall) (1♀, Boxtel, 21.v.1988).

DISCUSSION

The new observations can be compared to data from the literature on pompilids in The Netherlands (Benno, 1969; Bouwman, 1915ab, 1916; Chrysanthus, 1947; Lefeber and Van Ooijen, 1988; Thijsse, 1907; Walrecht, 1936) and nearby countries (Bristowe, 1948; Day, 1981, 1988; Oehlke and Wolf, 1987; Wahis, 1948, 1955, 1962; Wolf, 1971). A summary with references included is given in Table 1. Comments for each pompilid species follow hereafter.

Anoplius concinnus was found with wolf spiders (Lycosidae) as prey. This is in agreement with the literature, where several genera of Lycosidae are mentioned.

Both in The Netherlands and in other countries, a preference for wolf spiders has been recorded for *Anoplius infuscatus*. Beside these, Thomisidae and Agelenidae are mentioned. Most members of these families are 'sit-and-wait' predators, but there are some exceptions, for instance *Thanatus* species and the males of *Textrix* species. So, the available data may point to a preference for ground dwelling spiders.

Anoplius viaticus appeared to prey almost exclusively on the wolf spider *Trochosa terricola* (Lycosidae). These observations are neither restricted to one locality, nor to a short period. Only in two of 41 cases (5%), *A. viaticus* caught other species: *Pardosa monticola* (Lycosidae) and *Agroeca brunnea* (Clubionidae). This suggests that *A. viaticus* did not simply catch the most abundant wandering spider, but rather searched actively for *T. terricola*. In literature on The Netherlands, the *Lycosa* sp. mentioned by Thijsse (1907) might refer to almost any modern lycosid genus. From data on prey elsewhere, the list given by Bristowe (1948) matches our data very well: he found in only seven of 47 cases (15%) prey that were not *Trochosa terricola*. However, other papers indicate several families and genera. Some are hunters by day like Lycosidae, while others are nocturnal hunters (*Drassodes*) or inhabitants of sheet webs (*Agelena*). Common attributes of the recorded spider genera are their medium to large size (5-13 mm) and the strata they occupy: on or near ground level. Most also prefer rather dry and/or sandy places as does *A. viaticus* (*Thanatus*, *Aelurillus*, *Pardosa monticola*, *Trochosa terricola*), but this is not true for

Predator	Prey
Anoplius concinnus	**Lycosidae** (D2): *Arctosa* (O&W), *Pardosa* sp. (K&P, L&VO, O&V), *Trochosa ruricola* (K&P)
Anoplius infuscatus	**Thomisidae** (D2): *Thanatus* (O&W). **Lycosidae** (D2, K&P): *Alopecosa accentuata* (K&P), *Arctosa* (O&W), *Pardosa* (O&W), *Pirata* (O&W), *Tricca* (O&W), *Trochosa* (L&VO, O&W), *Xerolycosa* (O&W). **Agelenidae** (D2): *Textrix* (O&W).
Anoplius viaticus	**Gnaphosidae** (D2): *Drassodes* (O&W). **Clubionidae:** *Agroeca brunnea* (K&P). **Thomisidae** (D2): *Thanatus* (O&W). **Salticidae** (D2): *Aelurillus* (O&W). **Lycosidae** (D2, T): *Alopecosa* (O&W; sub *Tarentula*), *A. accentuata* (B: sub *Tarentula a.*), *A. aculeata* (W3), *A. pulverulenta* (B, W2: sub *Tarentula carinata*), *Arctosa* (O&W), *A. perita* (B), *Pardosa* (O&W), *P. hortensis* (W2), *P. monticola* (B, K&P), *Trochosa* (O&W), *T. terricola* (B, K&P, W3). **Pisauridae**: *Pisaura mirabilis* (O&W, W2). **Agelenidae** (D2): *Agelena* (O&W).
Arachnospila rufa	**Gnaphosidae** (D2): *Drassodes* (O&W), *Gnaphosa* (O&W). **Clubionidae** (D2): *Cheiracanthium* (O&W). **Salticidae** (D2): *Aelurillus* (O&W). **Lycosidae** (D2): *Alopecosa* (O&W: sub *Tarentula*), *A. fabrilis* (P&K), *Trochosa* (O&W).
Auplopus carbonarius	**Zoropsidae**: *Zoropsis* (Wo). **Segestriidae** (D2): *Segestria* (Wo). **Gnaphosidae** (D2): *Aphantaulax* (Wo), *Haplodrassus* sp. (K&P). **Clubionidae** (D2): *Cheiracanthium* (Wo), *Clubiona* (Wo), *C. brevipes* (K&P). **Anyphaenidae** (D2). **Thomisidae** (D2): *Philodromus* (Wo). **Salticidae** (D2): *Dendryphantes* (Wo), *Evarcha* (Wo), *Sitticus* (Wo). **Lycosidae** (D2): *Lycosa* (Wo), *Trochosa* (Wo). **Agelenidae** (D2): *Agelena* (Wo). **Tetragnathidae**: *Meta* (Wa).
Episyron rufipes	**Lycosidae** (D2: only some cases). **Tetragnathidae**: *Meta* (D2). **Araneidae**: *Agelenatea redii* (B: sub *Araneus r.*), *Araneus* (D2, O&W), *A. diadematus* (B), *Argiope* (O&W), *Gibbaranea gibbosa* (L&VO; sub *Araneus gibbosus*), *Larinioides cornutus* (B: sub *A. foliata*, K&P), *Nuctenea umbratica* (K&P).
Pompilus cinereus	**Atypidae**: *Atypus* sp. (C). **Zoropsidae**: *Zoropsis* (O&W). **Gnaphosidae** (D1): *Pterotricha* (O&W). **Clubionidae** (D1): *Cheiracanthium* (O&W). **Zoridae** (D1): *Zora* (O&W). **Thomisidae** (D1): *Xysticus* (O&W). **Salticidae**: *Aelurillus* (O&W), *Ballus* (C: not sure). **Lycosidae** (B1, C, D1, K&P): *Alopecosa* (O&W: sub *Tarentula*), *Arctosa* (O&W), *A. perita* (B, B1, D1, D2, L&VO), *Pardosa* (O&W), *Pirata* (O&W), *Trochosa* (O&W), *Xerolycosa* (D1, D2). **Pisauridae** (D1): *Dolomedes* (O&W). **Araneidae**: *Araneus* (O&W).
Caliadurgus fasciatellus	**Tetragnathidae**: *Meta* (D2, O&W), *M. segmentata* (L&VO). **Araneidae**: *Agelenatea redii* (K&P) *Araneus* (D2, O&W), *A. alsine* (B2), *A. diadematus* (Be, B2, W1), *A. quadratus* (W1).
Dipogon subintermedius	**Segestriidae**: *Segestria* (O&W), *S. senoculata* (D2, K&P). **Salticidae**: *Salticus* (O&W).
Priocnemis fennica	**Clubionidae**: *Clubiona terrestris* (K&P). **Lycosidae**: *Pardosa pullata* (D2).
Priocnemis minuta	**Gnaphosidae** (K&P).
Priocnemis susterai	**Gnaphosidae**: *Drassodes* (O&W), *D. cupreus* (K&P).

TABLE 1. Summary of the prey records in the literature for the pompilid species for which this study gives new data. References are abbreviated: B = Bristowe, 1948; Be = Benno, 1969; B1 = Bouwman, 1915b; B2 = Bouwman, 1916; C = Chrysanthus, 1947; D1 = Day, 1981; D2 = Day, 1988; K&P = Koomen & Peeters, this study; L&VO = Lefeber and Van Ooijen, 1988; O&W = Oehlke and Wolf, 1987; T = Thijsse, 1907; Wa = Walrecht, 1936; Wo = Wolf, 1971; W1 = Wahis, 1948; W2 = Wahis, 1955; W3 = Wahis, 1962.

Agroeca brunnea, an inhabitant of wet places. So, although our observations and Bristowe (1948) suggest a strong preference for only one species of Lycosidae, data from other countries show a much broader spectrum of prey. This may point to a preference for *Trochosa terricola*, that is abandoned when the latter species is not available.

Arachnospila rufa is not selective: spiders with various sizes, and from several habitats and strata have been recorded. Our observations support these data.

For *Auplopus carbonarius*, the observations that Segestriidae, *Clubiona brevipes*, Anyphaenidae, and *Dendryphantes* were prey items may point to a preference for spiders that walk along, or hide in crevices in, vertical planes, e.g. walls or tree-trunks. Species with (at least occasionally) similar habits are found in most of the other families and genera recorded (*Zoropsis*, *Aphantaulax*, *Haplodrassus*, *Philodromus*, *Evarcha*, *Sitticus*, *Agelena*, *Meta*), but without species identifications, the hypothesis that *A. carbonarius* is mainly a vertical hunter cannot be supported or falsified. Several authors note that *A. carbonarius* has a habit of amputating the legs of its preys (e.g., Grandi, 1961: fig. 48; Oehlke and Wolf, 1987). This did not occur in the two cases we noted. Both the *Haplodrassus* and the *Clubiona* prey still had all of their legs.

Episyron rufipes was found to prey upon two araneid spiders. Using data from other countries (see Table 1) it can be deduced that *E. rufipes* specializes on orbweb building spiders.

For *Pompilus cinereus* many different prey are known, including burrowing spiders (*Atypus*), orbweb building spiders (*Araneus*), and xerophylic (*Arctosa perita*, *Aelurillus*) and hygrophylic species (*Dolomedes*). This suggests no specificity at all. To date, only one juvenile wolf spider can be added.

Caliadurgus fasciatellus is a second pompilid species that is obviously specialized in capturing orbweb building spiders. The *Araneus redii* prey fits well within these data (Table 1).

The recorded prey of *Dipogon subintermedius*

are in conformity with its observed hunting places: tree-trunks and piles of fences. *Segestria senoculata* is known to build its retreat in these places, and jumping spiders from the genus *Salticus* may also be found there.

For the three species of *Priocnemis*, viz., *P. fennica*, *P. minuta*, and *P. susterai*, reliable data from the literature are few, because formerly these species were not distinguished as separate taxa. Prey recorded so far do not suggest any high degree of selectivity.

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